FIG. 1

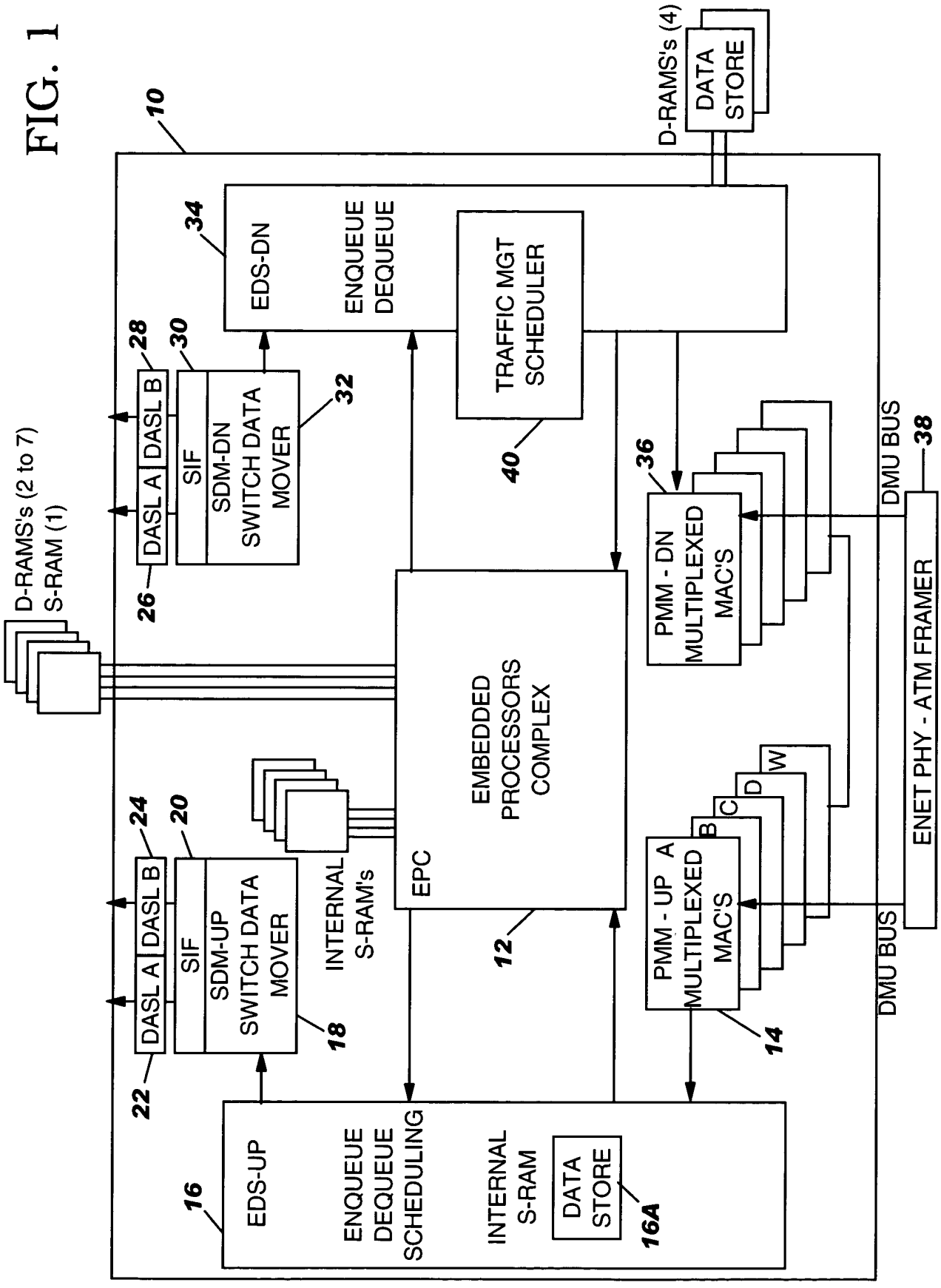

10
D-RAMS's (4)
DATA STORE
34
EDS-DN
ENQUEUE
DEQUEUE
TRAFFIC MGT SCHEDULER
40
28
30
DASL B
DASL A
SIF
SDM-DN SWITCH DATA MOVER
32
26
D-RAMS's (2 to 7)
S-RAM (1)
36
PMM - DN MULTIPLEXED MAC'S
DMU BUS
38
ENET PHY - ATM FRAMER
EMBEDDED PROCESSORS COMPLEX
EPC
12
INTERNAL S-RAM's
24
20
DASL B
DASL A
SIF
SDM-UP SWITCH DATA MOVER
18
22
PMM - UP MULTIPLEXED MAC'S
A
B
C
D
W
14
DMU BUS
16
EDS-UP
ENQUEUE
DEQUEUE
SCHEDULING
INTERNAL S-RAM
DATA STORE
16A

FIG. 2

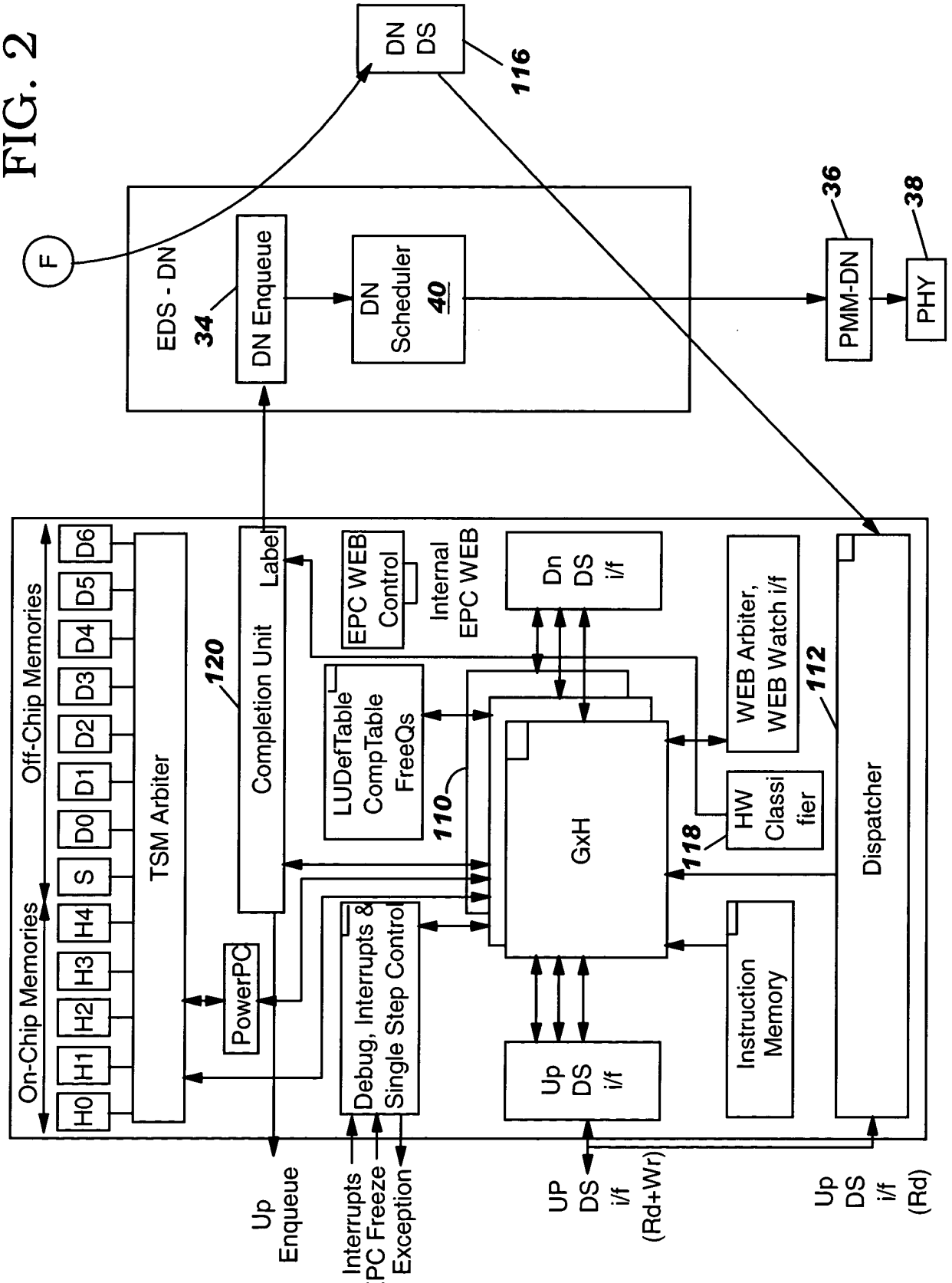

DN DS
116
F
EDS - DN
34
DN Enqueue
DN Scheduler
40
PMM-DN
36
PHY
38
On-Chip Memories
Off-Chip Memories
H0
H1
H2
H3
H4
S
D0
D1
D2
D3
D4
D5
D6
TSM Arbiter
120
Completion Unit
Label
EPC WEB Control
Internal EPC WEB
Dn DS i/f
LUDefTable
CompTable
FreeQs
110
GxH
WEB Arbiter,
WEB Watch i/f
112
HW Classi fier
118
Dispatcher
PowerPC
Debug, Interrupts & Single Step Control
Up DS i/f
Instruction Memory
Up Enqueue
Interrupts
EPC Freeze
Exception
UP DS i/f (Rd+Wr)
Up DS i/f (Rd)

FIG. 3

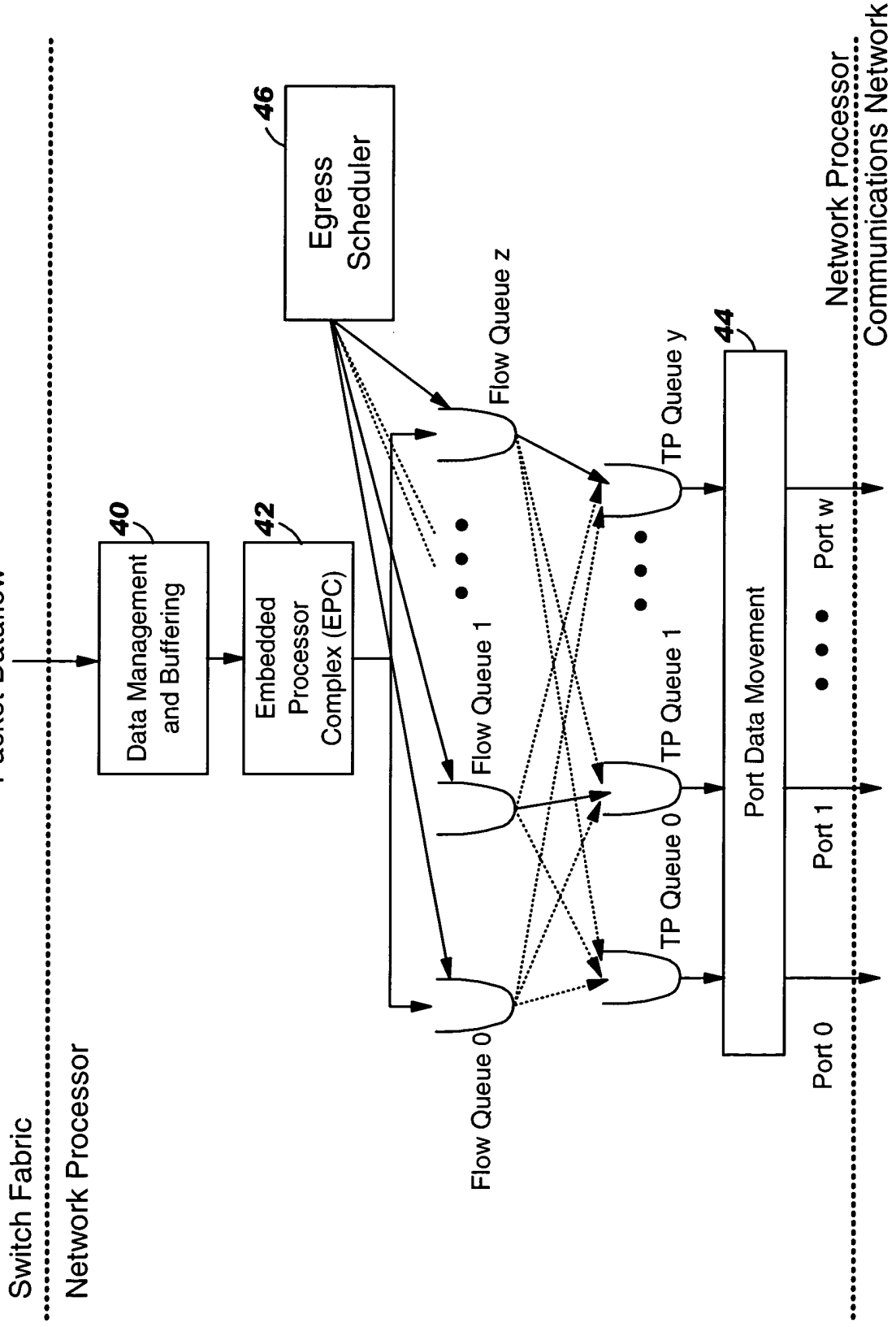

Egress Dataflow Diagram
Switch Fabric
Network Processor
Packet Dataflow
40
Data Management and Buffering
42
Embedded Processor Complex (EPC)
46
Egress Scheduler
Flow Queue 0
Flow Queue 1
Flow Queue z
TP Queue 0
TP Queue 1
TP Queue y
44
Port Data Movement
Port 0
Port 1
Port w
Network Processor
Communications Network

FIG. 4

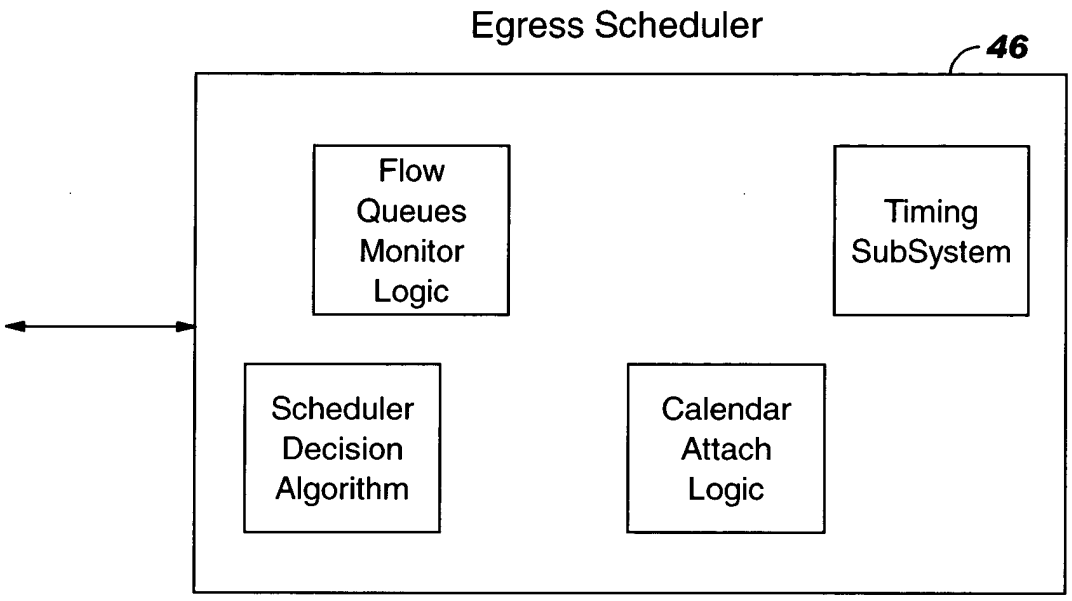

Egress Scheduler
46
Flow Queues Monitor Logic
Timing SubSystem
Scheduler Decision Algorithm
Calendar Attach Logic

FIG. 5

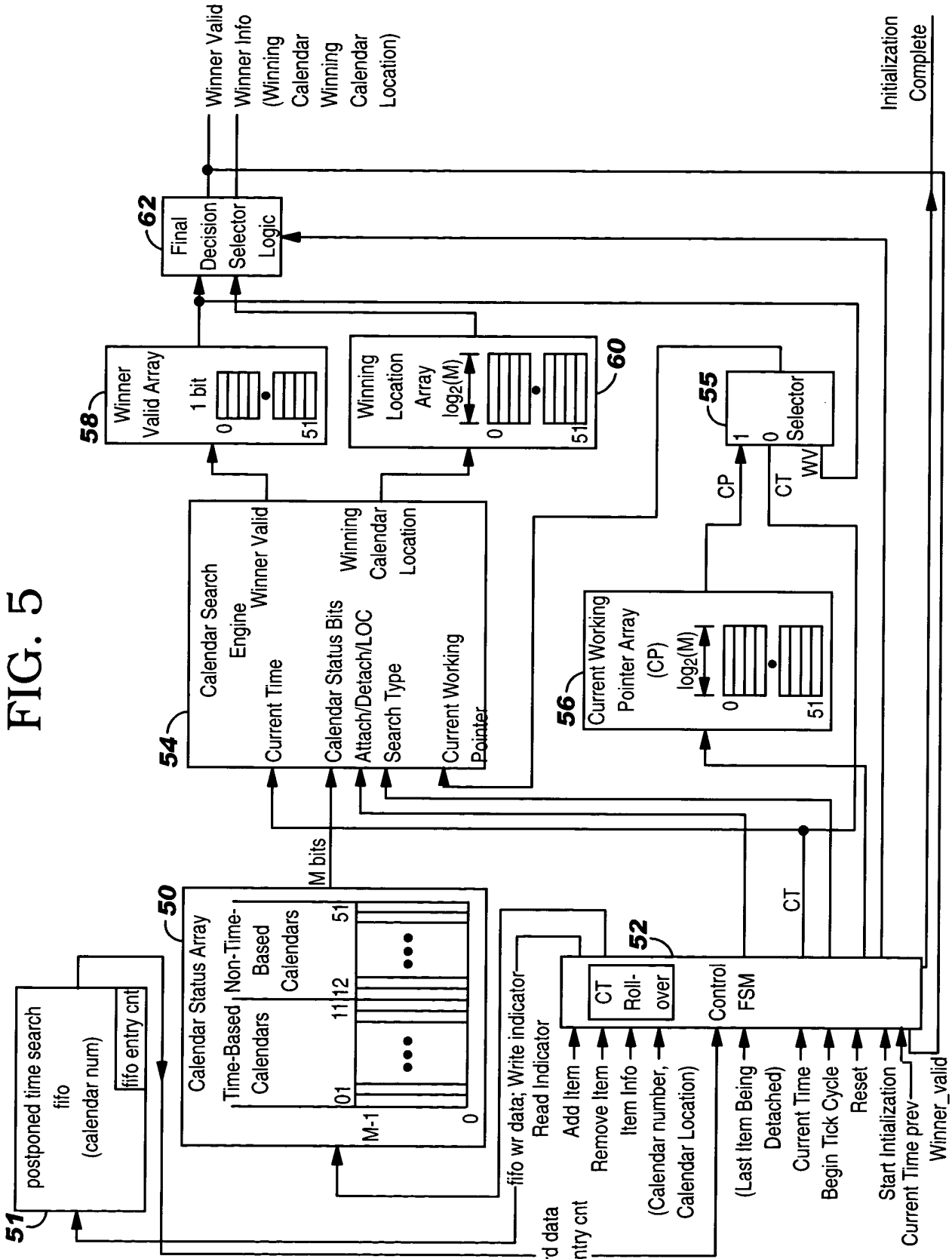

51
postponed time search fifo
(calendar num)
fifo entry cnt
50
Calendar Status Array
Time-Based Calendars
Non-Time-Based Calendars
M-1
0
01
11
12
51
M bits
54
Calendar Search Engine
Current Time
Calendar Status Bits
Attach/Detach/LOC
Search Type
Current Working Pointer
Winner Valid
Winning Calendar Location
58
Winner Valid Array
1 bit
0
51
60
Winning Location Array
log2(M)
0
51
62
Final Decision Selector Logic
Winner Valid
Winner Info (Winning Calendar Winning Calendar Location)
55
1
0
Selector
WV
CT
CP
56
Current Working Pointer Array (CP)
log2(M)
0
51
52
CT Roll-over
Control FSM
CT
fifo wr data; Write indicator
Read Indicator
Add Item
Remove Item
Item Info
(Calendar number, Calendar Location)
fifo rd data
fifo entry cnt
(Last Item Being Detached)
Current Time
Begin Tick Cycle
Reset
Start Intialization
Current Time prev
Winner_valid
Initialization Complete

FIG. 6A

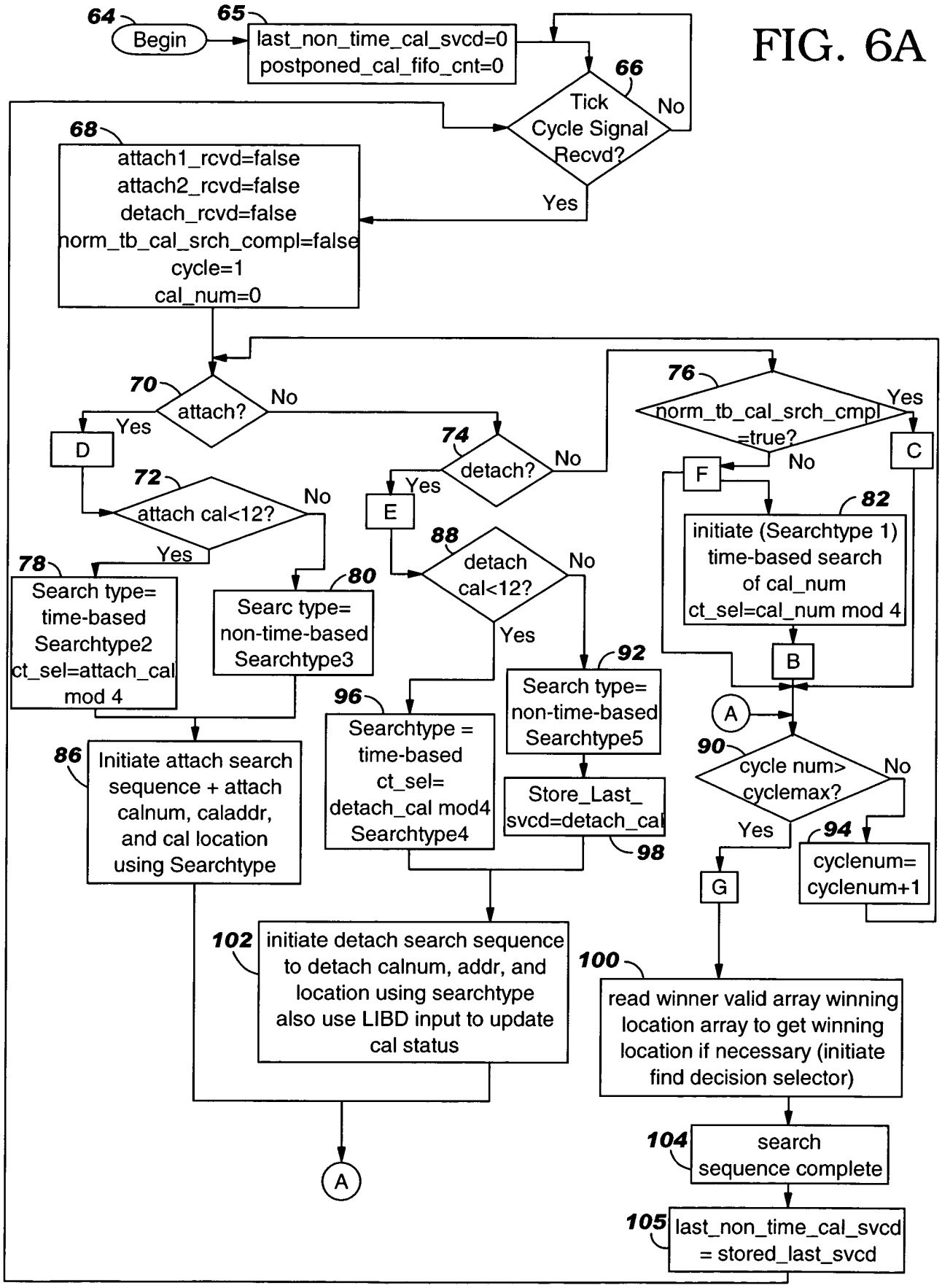

64
Begin
65
last_non_time_cal_svcd=0
postponed_cal_fifo_cnt=0
66
Tick Cycle Signal Recvd?
No
Yes
68
attach1_rcvd=false
attach2_rcvd=false
detach_rcvd=false
norm_tb_cal_srch_compl=false
cycle=1
cal_num=0
70
attach?
No
Yes
D
72
attach cal<12?
No
Yes
78
Search type= time-based Searchtype2 ct_sel=attach_cal mod 4
80
Searc type= non-time-based Searchtype3
74
detach?
No
Yes
E
88
detach cal<12?
No
Yes
76
norm_tb_cal_srch_cmpl =true?
Yes
No
C
F
82
initiate (Searchtype 1) time-based search of cal_num ct_sel=cal_num mod 4
B
A
90
cycle num> cyclemax?
No
Yes
94
cyclenum= cyclenum+1
G
92
Search type= non-time-based Searchtype5
Store_Last_ svcd=detach_cal
98
96
Searchtype = time-based ct_sel= detach_cal mod4 Searchtype4
86
Initiate attach search sequence + attach calnum, caladdr, and cal location using Searchtype
102
initiate detach search sequence to detach calnum, addr, and location using searchtype also use LIBD input to update cal status
100
read winner valid array winning location array to get winning location if necessary (initiate find decision selector)
104
search sequence complete
105
last_non_time_cal_svcd = stored_last_svcd
A

FIG. 6B

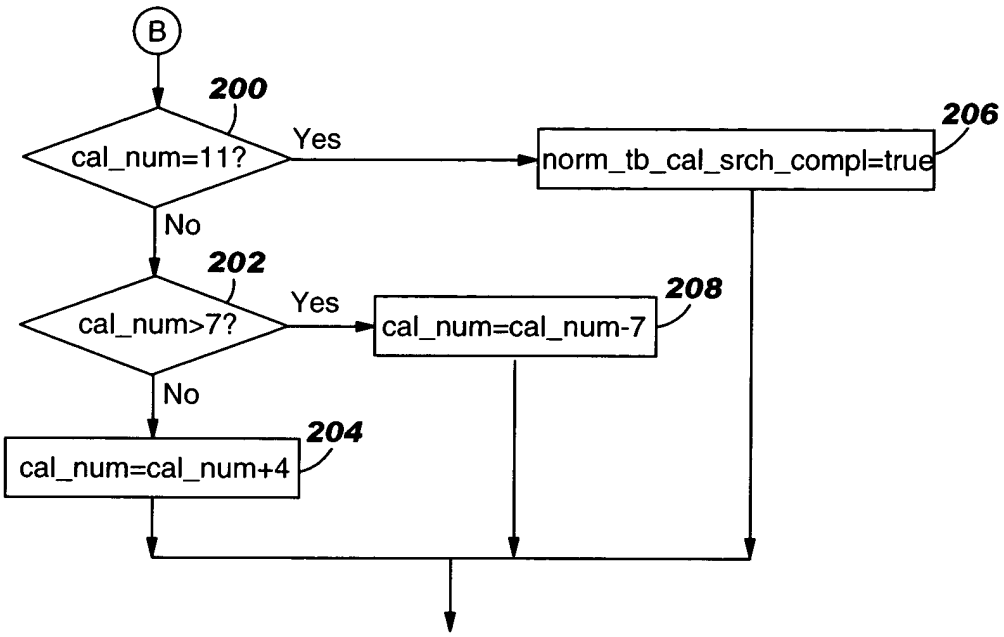

B
200
cal_num=11?
Yes
206
norm_tb_cal_srch_compl=true
No
202
cal_num>7?
Yes
208
cal_num=cal_num-7
No
204
cal_num=cal_num+4
To FIG. 6A Block 90

FIG. 6C

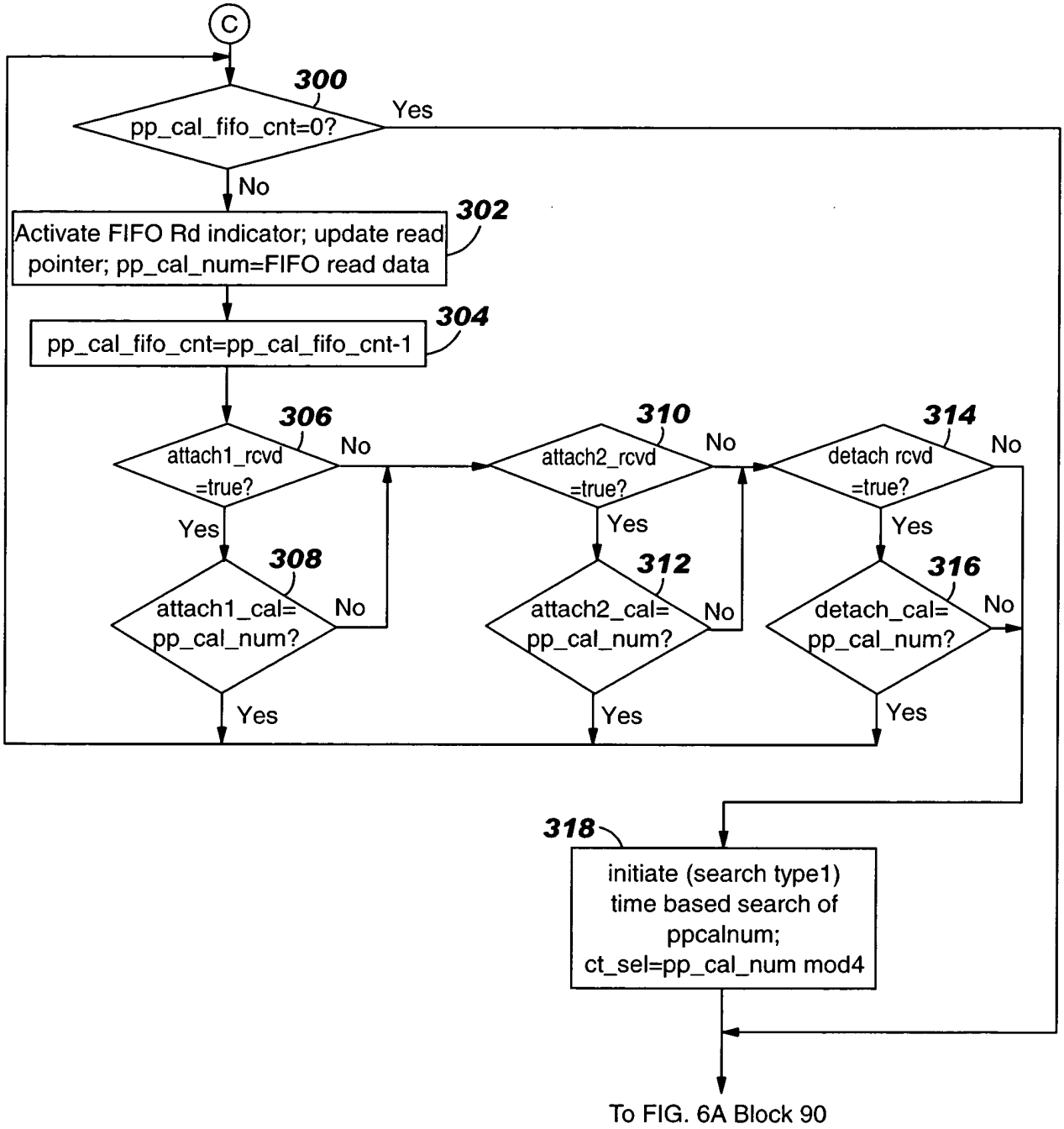

C
300
pp_cal_fifo_cnt=0?
Yes
No
302
Activate FIFO Rd indicator; update read pointer; pp_cal_num=FIFO read data
304
pp_cal_fifo_cnt=pp_cal_fifo_cnt-1
306
attach1_rcvd =true?
No
Yes
308
attach1_cal= pp_cal_num?
No
Yes
310
attach2_rcvd =true?
No
Yes
312
attach2_cal= pp_cal_num?
No
Yes
314
detach rcvd =true?
No
Yes
316
detach_cal= pp_cal_num?
No
Yes
318
initiate (search type1) time based search of ppcalnum; ct_sel=pp_cal_num mod4
To FIG. 6A Block 90

FIG. 6D

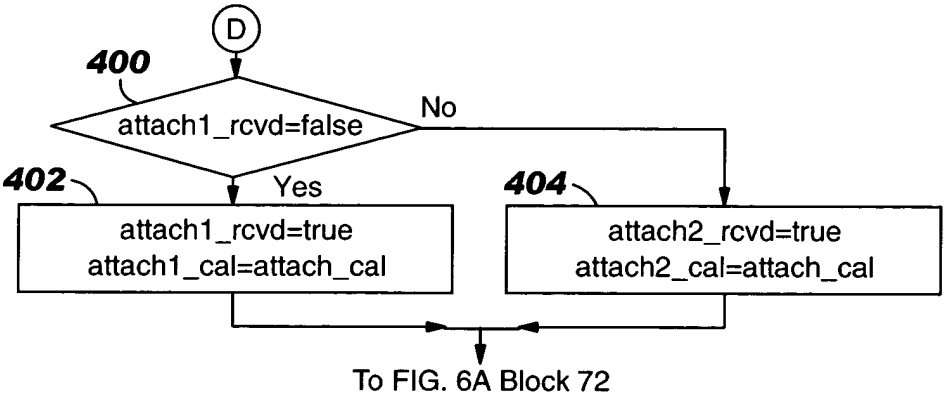


FIG. 6E

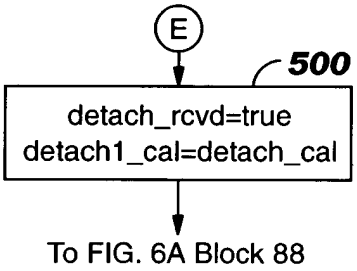


FIG. 6F

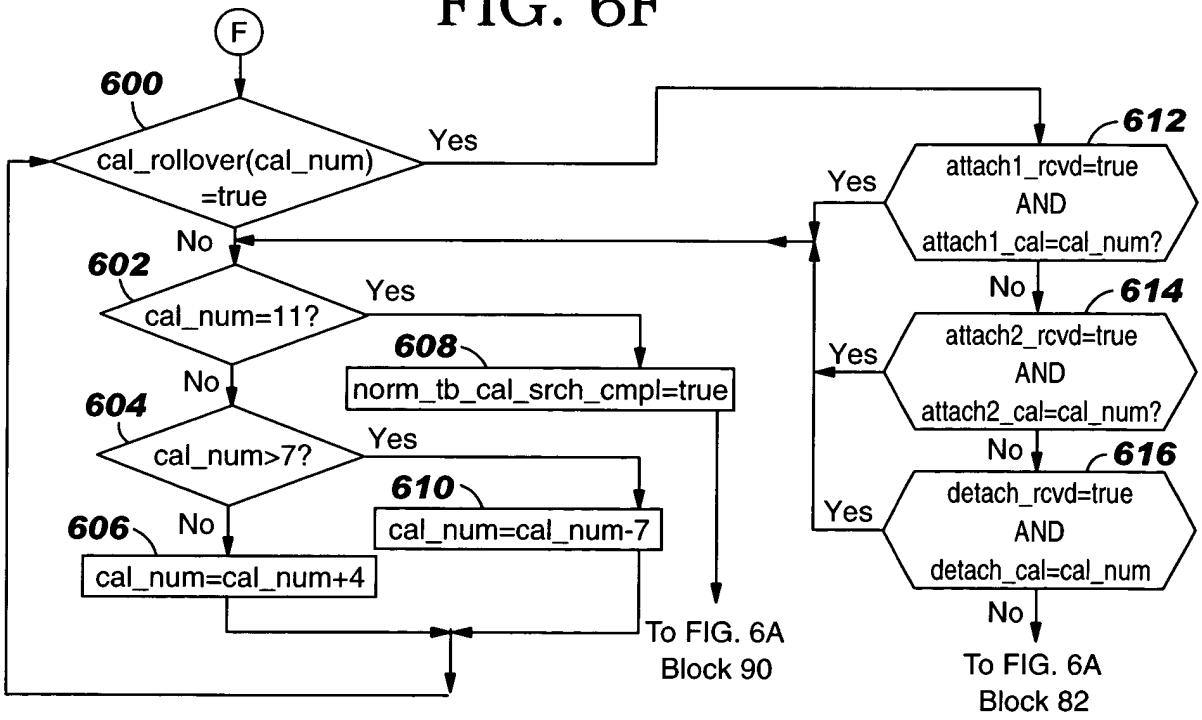


FIG. 6G

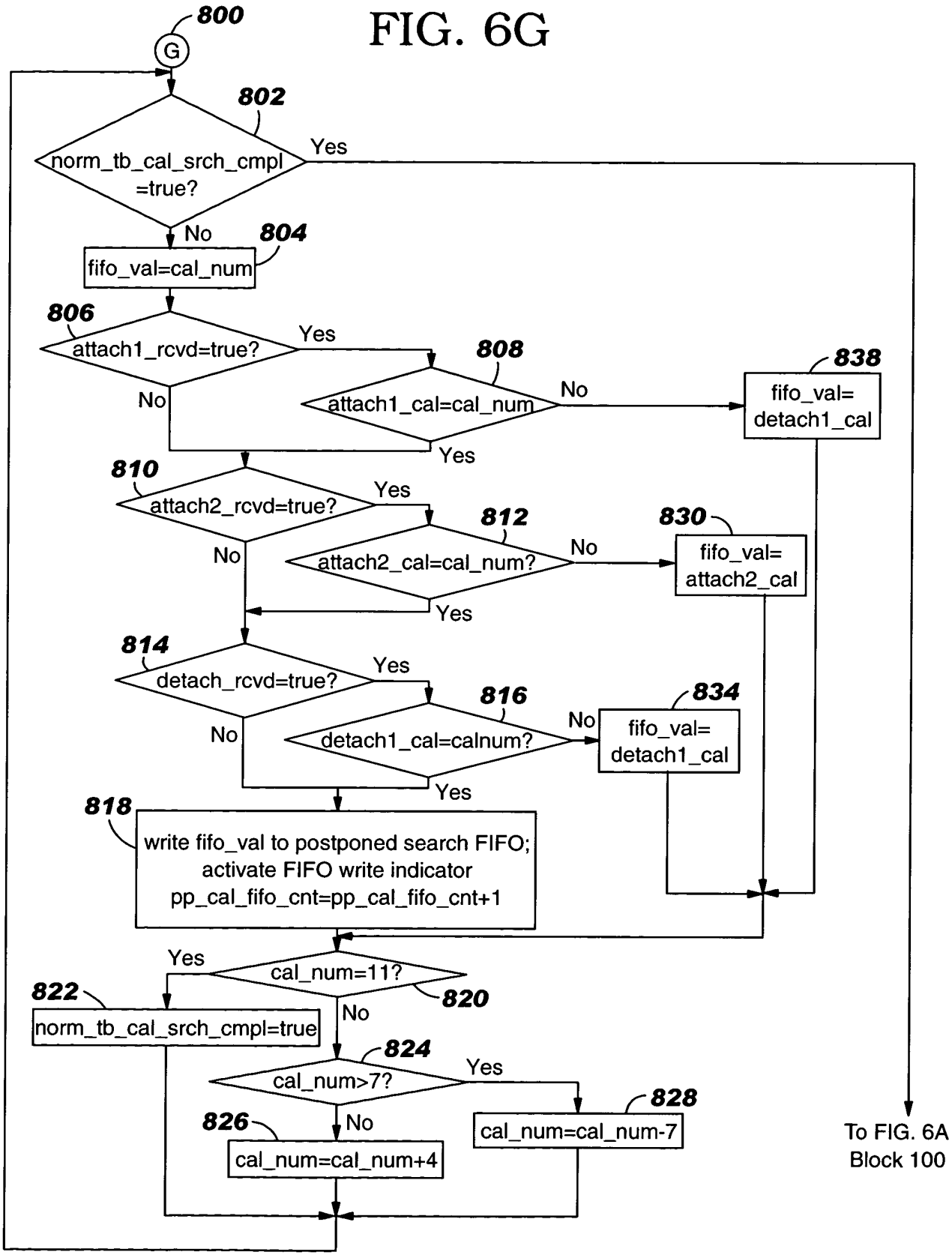

800
G
802
norm_tb_cal_srch_cmpl =true?
Yes
No
804
fifo_val=cal_num
806
attach1_rcvd=true?
Yes
No
808
attach1_cal=cal_num
No
Yes
838
fifo_val= detach1_cal
810
attach2_rcvd=true?
Yes
No
812
attach2_cal=cal_num?
No
Yes
830
fifo_val= attach2_cal
814
detach_rcvd=true?
Yes
No
816
detach1_cal=calnum?
No
Yes
834
fifo_val= detach1_cal
818
write fifo_val to postponed search FIFO;
activate FIFO write indicator
pp_cal_fifo_cnt=pp_cal_fifo_cnt+1
Yes
cal_num=11?
820
No
822
norm_tb_cal_srch_cmpl=true
824
cal_num>7?
Yes
No
826
cal_num=cal_num+4
828
cal_num=cal_num-7
To FIG. 6A
Block 100

FIG. 7

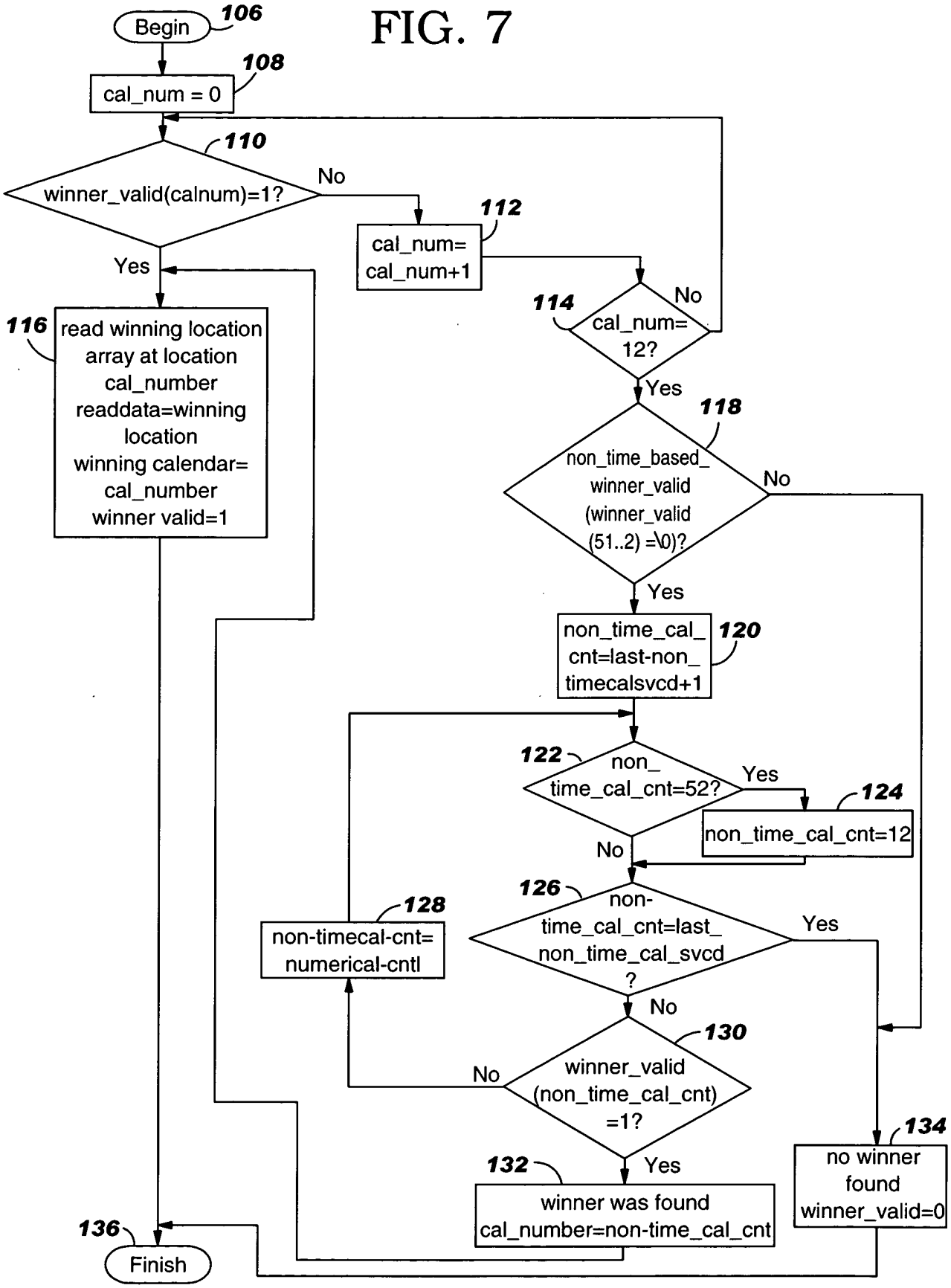

Begin
106
cal_num = 0
108
110
winner_valid(calnum)=1?
No
Yes
112
cal_num= cal_num+1
114
cal_num= 12?
No
Yes
116
read winning location array at location cal_number readdata=winning location winning calendar= cal_number winner valid=1
118
non_time_based_ winner_valid (winner_valid (51..2) =\0)?
No
Yes
120
non_time_cal_ cnt=last-non_ timecalsvcd+1
122
non_ time_cal_cnt=52?
Yes
124
non_time_cal_cnt=12
No
126
non- time_cal_cnt=last_ non_time_cal_svcd ?
Yes
128
non-timecal-cnt= numerical-cntl
No
130
winner_valid (non_time_cal_cnt) =1?
No
Yes
132
winner was found cal_number=non-time_cal_cnt
134
no winner found winner_valid=0
136
Finish

FIG. 8

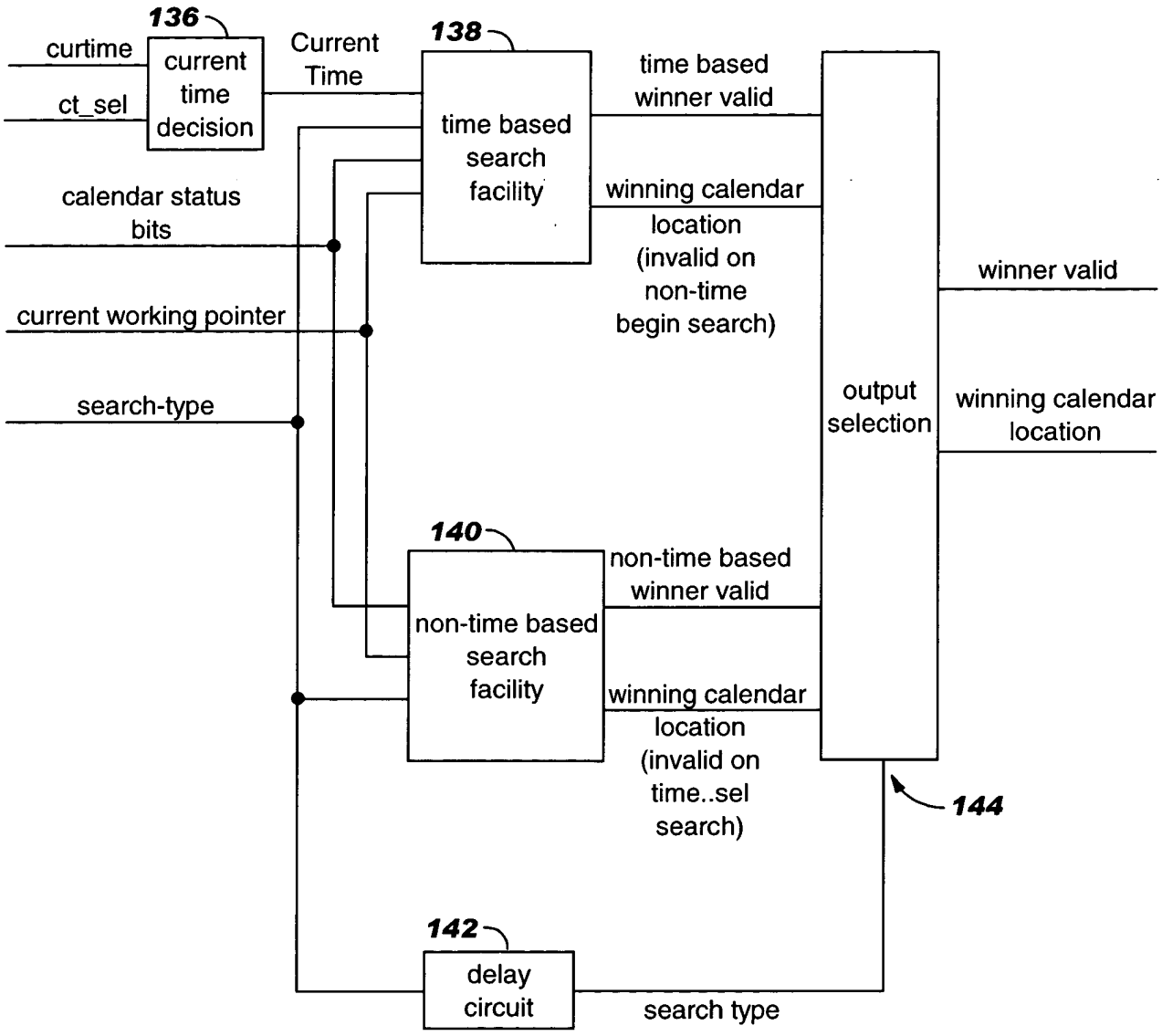

136
curtime
ct_sel
current time decision
Current Time
138
time based search facility
time based winner valid
winning calendar location (invalid on non-time begin search)
calendar status bits
current working pointer
search-type
output selection
winner valid
winning calendar location
140
non-time based search facility
non-time based winner valid
winning calendar location (invalid on time..sel search)
144
142
delay circuit
search type

FIG. 9

TABLE I. Initialization

Clock Cycle Number	Array Location	Array Name(s)	Access Type	Write Data
1	0	Calendar Status CP Winner Valid	Write Write Write	All Zeroes All Zeroes Zero
2	1	Calendar Status CP Winner Valid	Write Write Write	All Zeroes All Zeroes Zero
3	2	Calendar Status CP Winner Valid	Write Write Write	All Zeroes All Zeroes Zero
4	3	Calendar Status CP Winner Valid	Write Write Write	All Zeroes All Zeroes Zero
.	.	Calendar Status CP Winner Valid	Write Write Write	All Zeroes All Zeroes Zero
.	.	Calendar Status CP Winner Valid	Write Write Write	All Zeroes All Zeroes Zero
.	.	Calendar Status CP Winner Valid	Write Write Write	All Zeroes All Zeroes Zero
50	49	Calendar Status CP Winner Valid	Write Write Write	All Zeroes All Zeroes Zero
51	50	Calendar Status CP Winner Valid	Write Write Write	All Zeroes All Zeroes Zero
52	51	Calendar Status CP Winner Valid	Write Write Write	All Zeroes All Zeroes Zero

FIG. 10

TABLE II. Search Sequence with Neither Attaches Nor Detaches

Clock Cycl Number	Array Location	Array Name(s)	Access Type	Write Data	Search Engine Inputs	Search Engine Output
1	0	Calendar Status	Read	N/A	N/A	N/A
1	0	CP	Read	N/A	N/A	N/A
2	1	Calendar Status	Read	N/A	Calendar 0 Status	N/A
2	1	CP	Read	N/A	Calendar 0 CP Time-based search	N/A
3	2	Calendar Status	Read	N/A	Calendar 1 Status	Calendar 0 Search
3	2	CP	Read	N/A	Calendar 1 CP	
3	0	Winner Valid	Write	Search Engine Winner_Valid Output	Time-based Search	
3	0	Winning Location	Write	Search Engine Winning_ Location Output		
4	3	Calendar Status	Read	N/A	Calendar 2 Status	Calendar 1 Search
4	3	CP	Read	N/A	Calendar 2 CP	
4	1	Winner Valid	Write	Search Engine Winner_Valid Output	Time-based Search	
4	1	Winning Location	Write	Search Engine Winning_ Location Output		
5	4	Calendar Status	Read	N/A	Calendar 3 Status	Calendar 2 Search
5	4	CP	Read	N/A	Calendar 3 CP	
5	2	Winner Valid	Write	Search Engine Winner_Valid Output	Time-based Search	
5	2	Winning Location	Write	Search Engine Winning_ Location Output		
6	5	Calendar Status	Read	N/A	Calendar 4 Status	Calendar 3 Search

FIG. 10 (cont'd)

TABLE II (cont'd)

6	5	CP	Read	N/A	Calendar 4 CP	
6	3	Winner Valid	Write	Search Engine Winner_Valid Output	Time-based Search	
6	3	Winning Location	Write	Search Engine Winning_ Location Output		
7	6	Calendar Status	Read	N/A	Calendar 5 Status	Calendar 4 Search
7	6	CP	Read	N/A	Calendar 5 CP	
7	4	Winner Valid	Write	Search Engine Winner_Valid Output	Time-based Search	
7	4	Winning Location	Write	Search Engine Winning_ Location Output		
8	7	Calendar Status	Read	N/A	Calendar 6 Status	Calendar 5 Search
8	7	CP	Read	N/A	Calendar 6 CP	
8	5	Winner Valid	Write	Search Engine Winner_Valid Output	Time-based Search	
8	5	Winning Location	Write	Search Engine Winning_ Location Output		
.						
.						
.						
12	11	Calendar Status	Read	N/A	Calendar 10 Status	Calendar 9 Search
12	11	CP	Read	N/A	Calendar 10 CP	
12	9	Winner Valid	Write	Search Engine Winner_Valid Output	Time-based Search	
12	9	Winning Location	Write	Search Engine Winning_ Location Output		
13	N/A	Calendar Status	Read	N/A	Calendar 11 Status	Calendar 10 Search
13	N/A	CP	Read	N/A	Calendar 11 CP	
13	10	Winner Valid	Write	Search Engine Winner_Valid Output	Time-based Search	
13	10	Winning Location	Write	Search Engine Winning_ Location Output		

FIG. 10 **(cont'd)**

TABLE II (cont'd)

14	N/A	N/A	N/A	N/A	N/A	Calendar 11 Search
14	N/A	N/A	N/A	N/A	N/A	
14	11	Winner Valid	Write	Search Engine Winner_Valid Output		
14	11	Winning Location	Write	Search Engine Winning_ Location Output		
15	1st winner found in Winner Valid Array	Winning Location	Read	N/A	N/A	Winner_Valid and Winner Info is at the output
16	No Activity					
17	No Activity					
18	No Activity					
19	No Activity					
20	Winning Index	Winning location	Read	N/A		

FIG. 11

TABLE III. **Type I Search**

Clock Cycle Number	Array Location	Array Name(s)	Access Type	Write Data	Search Engine Inputs	Search Engine Output	Comments
1	N	Calendar Status	Read	N/A	N/A	N/A	Cycle initiated
1	N	Winner_Walid	Read	N/A	N/A	N/A	If the Winner_valid value for location N is logic 0, the CP value that is presented to the search engine on cycle 2 will be equal to the Calendar N CT, as per the algorithm definition
1	N	CP	Read	N/A	N/A	N/A	
2	N/A	N/A	N/A		Calendar N Status Calendar N CP Calendar N CT Time-based Search No Attach No Detach	N/A	First cycle of Calendar N Search, No attaches nor detaches
3	N	Winner Valid	Write	Search Engine Winner_Valid Output	N/A	Winner_Valid and Winning_Location	
3	N	Winning Location	Write	Search Engine Winning_ Location Output	N/A		

FIG. 12

TABLE IV. Type II Search

Clock Cycle Number	Array Location	Array Name(s)	Access Type	Write Data	Search Engine Inputs	Search Engine Output	Comments
1	N	Calendar Status	Read	N/A	N/A	N/A	Cycle initiated. Calendar attach location is at input to structure
1	N	Winner_Walid	Read	N/A	N/A	N/A	If the Winner_Valid value for location N is logic 0, the CP value that is presented to the search engine on cycle 2 will be the Calendar N CT, as per the algorithm definition. If the value is logic 1, the CP_array read data will be the CP value used. (Time-based searches only)
1	N	CP	Read	N/A	N/A	N/A	
2	N/A	N/A	N/A		Calendar N Status Calendar N CP Calendar N CT Time-based Search Attach Indication Attach Calendar and Location		First cycle of Calendar N Search. The Search Engine takes into account that the Calendar Status does not reflect the current attach. State of the "pre-updated" attach status bit is reported to the top-level Egress Scheduler Structure
3	N	Winner Valid	Write	Search Engine Winner_Valid Output	N/A	Winner_Valid and Winning_Location	
3	N	Winning Location	Write	Search Engine Winning Location Output	N/A		
3	N	Calendar Status	Write	Logic 1 to bit position corresponding to attach location (other bits preserved)	N/A	N/A	Calendar status now reflects the attach.

FIG. 13

TABLE V. Type III Search

Clock Cycle Number	Array Location	Array Name(s)	Access Type	Write Data	Search Engine Inputs	Search Engine Output	Comments
1	M	Calendar Status	Read	N/A	N/A	N/A	Cycle Initiated. Calendar attach location is at input to structure
1	M	CP	Read	N/A	N/A	N/A	
2	N/A	N/A	N/A		Calendar M Status Calendar N CP (CP Array Read Data) Non-Time-based Search Attach Indication Attach Calendar and Location		First cycle of Calendar M Search. The Search Engine takes into account that the Calendar Status does not reflect the current attach. State of the "pre-updated" attach status bit is reported to the top-level Egress Scheduler Structure
3	M	Winner Valid	Write	Search Engine Winner_Valid Output	N/A	Winner_Valid and Winning_Location	
3	M	Winning Location	Write	Search Engine Winning_ Location Output	N/A		
3	M	Calendar Status	Write	Logic 1 to bit position corresponding to attach location (other bits preserved)	N/A	N/A	Calendar Status Array now reflects the attach.

FIG. 14

TABLE VI. Type IV Search

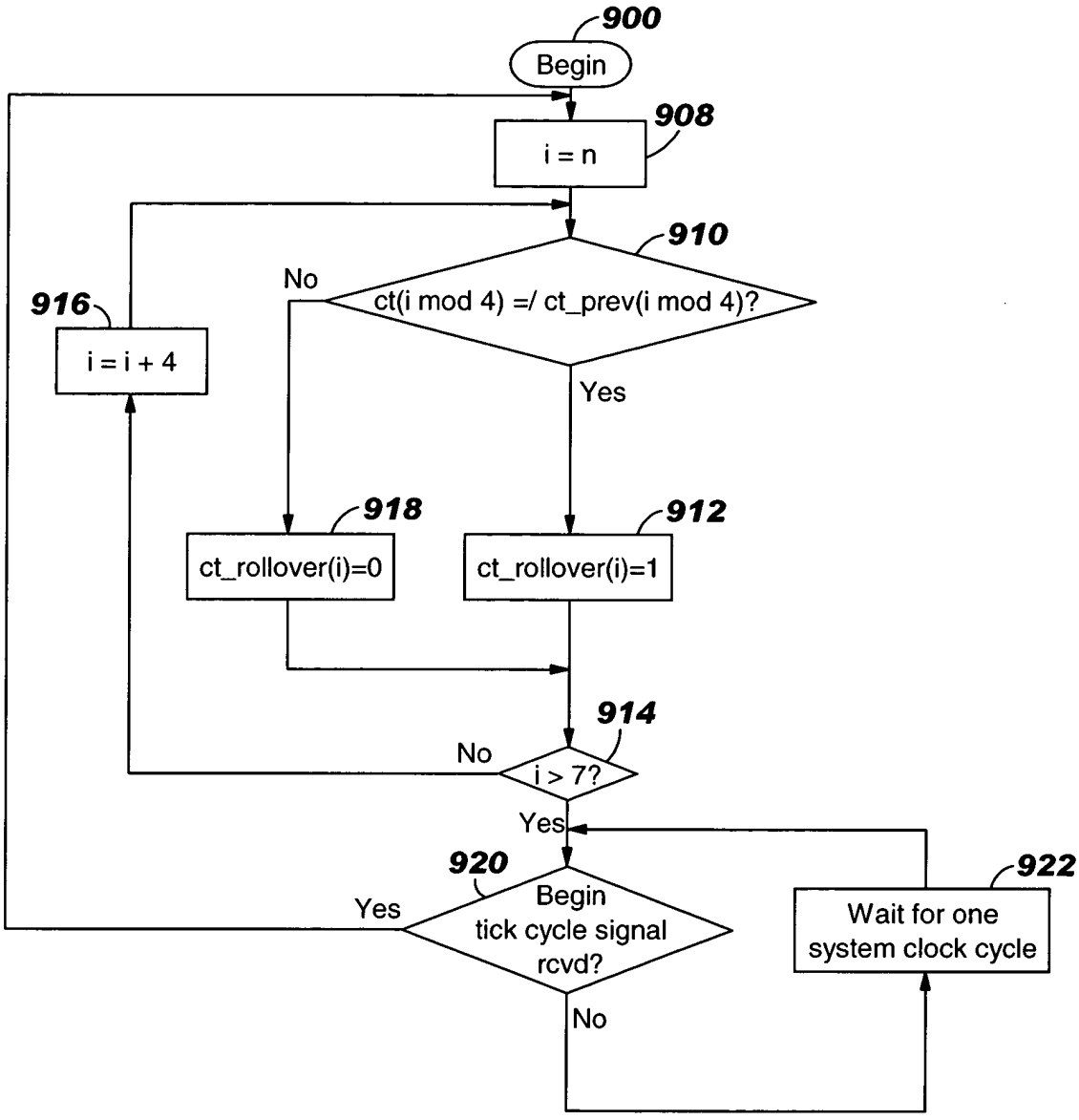
Clock Cycle Number	Array Location	Array Name(s)	Access Type	Write Data	Search Engine Inputs	Search Engine Output	Comments
1	N	CalendarStatus	Write	Write inverse of LIBD input to location corresponding to the Calendar detach location. Other bits preserved	N/A	N/A	Cycle initiated. Calendar attach location is at input to structure
2	N	Calendar Status	Read	N/A	N/A	N/A	
2	N	Winner_Walid	Read	N/A	N/A	N/A	If the Winner_valid value for location N is logic 0, the CP value that is presented to the search engine on cycle 3 will be the Calendar N CT, as per the algorithm definition. If the value is logic 1, the CP_array read data will be the CP value used. (Time-based searches only)
2	N	CP	Read	N/A	N/A	N/A	
3	N	CP	Write	Calendar Detach Location			
3	N/A	N/A	N/A		Calendar N Status Calendar N CP Calendar N CT Time-based Search Attach Indication Attach Calendar and Location		First cycle of Calendar N Search. The Search Engine takes into account that the Calendar Status does not reflect the current attach. State of the "pre-updated" attach status bit is reported to the top-level Egress Scheduler Structure
4	N	Winner Valid	Write	Search Engine Winner_Valid Output	N/A	Winner_Valid and Winning_Location	
4	N	WinningLocation	Write	Search Engine Winning_ Location Output	N/A		

FIG. 15

TABLE VII. Type V Search

Clock Cycle Number	Array Location	Array Name(s)	Access Type	Write Data	Search Engine Inputs	Search Engine Output	Comments
1	N	CalendarStatus	Write	Write inverse of LIBD input to location corresponding to the Calendar detach location. Other bits preserved	N/A	N/A	Cycle initiated. Calendar attach location is at input to structure
2	M	CalendarStatus	Read	N/A	N/A	N/A	Cycle Initiated. Calendar attach location is at input to structure
2	M	CP	Read	N/A	N/A	N/A	
3	N/A	N/A	N/A		Calendar M Status Calendar N CP (CP Array Read Data) Non-Time-based Search Attach Indication Attach Calendar and Location		First cycle of Calendar M Search. The Search Engine takes into account that the Calendar Status does not reflect the current attach. State of the "pre-updated" attach status bit is reported to the top-level Egress Scheduler Structure
4	M	Winner Valid	Write	Search Engine Winner_Valid Output	N/A	Winner_Valid and Winning_Location	
4	M	Winning Location	Write	Search Engine Winning_Location Output	N/A		
4	M	CalendarStatus	Write	Logic 1 to bit position corresponding to attach location (other bits preserved)	N/A	N/A	Calendar Status Array now reflects the attach.

FIG. 16


900
Begin
908
i = n
910
No
ct(i mod 4) =/ ct_prev(i mod 4)?
916
i = i + 4
Yes
918
ct_rollover(i)=0
912
ct_rollover(i)=1
914
No
i > 7?
Yes
920
Yes
Begin
tick cycle signal
rcvd?
922
Wait for one
system clock cycle
No